

**DEPARTMENT OF CONSUMER & INDUSTRY SERVICES  
RADIATION SAFETY SECTION  
IONIZING RADIATION RULES**

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## PART 11. PARTICLE ACCELERATOR INSTALLATIONS

### R325.5431. Purpose and scope.

**Rule 431. (1)** This part establishes procedures for the licensing or registration of particle accelerators, a classification system for particle accelerator installations and use, and radiation safety requirements for persons utilizing all types of particle accelerators except those specifically exempted from this part.

(2) This part applies to all licensees and registrants who use particle accelerators for any purpose other than those exempted under rule 432.

(3) In addition to the requirements of this part, all licensees and registrants are subject to the applicable provisions of the other parts.

### R325.5432. Definitions.

**Rule 432. (1)** "Particle accelerator" or "accelerator", as used in this part, means a radiation machine designed for or capable of accelerating electrically charged particles, such as electrons, protons or deuterons, with an electrical potential in excess of 1 MeV. Radiation machines designed and used exclusively for the production of electron beams or x-radiation for any of the following purposes except those capable of producing radioactive material in excess of exempt quantities listed in schedule B of rule 147 are excluded from this definition:

- (a) The diagnosis or treatment of patients.
- (b) Industrial radiography.
- (c) Examination of the microscopic structure of materials.
- (d) Manufacturing process control.
- (e) Research and development.
- (f) Demonstration of scientific principles for educational purposes.

(2) "Radiation protection supervisor" means 1 specific individual appointed by the licensee or registrant who has been delegated the responsibility and authority to govern the operation of the accelerator in such a manner as to comply with the provisions of this part and part 5 and to enforce any written procedures approved by the department.

*[Note: The requirements of this rule that pertain to radiation machine registration, licensing, or compliance are under the purview of the Michigan Department of Consumer & Industry Services.]*

## LICENSE OR REGISTRATION

### R325.5435. General provisions.

**Rule 435. (1)** Except as otherwise provided in these

rules, a person shall not manufacture, produce, own, receive, acquire, possess, use, transport, transfer or dispose of a research, production, processing or treatment particle accelerator capable of producing radioactive material in excess of exempt quantities listed in schedule B of rule 147 unless authorized in a specific license issued pursuant to part 2.

(2) Each person having a particle accelerator subject to this part shall comply with the registration requirements of part 4 unless the particle accelerator is licensed by a specific license issued pursuant to part 2.

*[Note: The requirements of this rule that pertain to radiation machine registration, licensing, or compliance are under the purview of the Michigan Department of Consumer & Industry Services.]*

## CLASSIFICATION

### R325.5437. Class enumeration.

**Rule 437. (1)** For the purpose of licensing or registering and approving particle accelerator installations they shall be classified as class AA, class A, class B, or class C.

(2) For the purpose of licensing or registering and approving mobile or portable particle accelerators intended for limited use at temporary job site locations this use shall be classified as class D operation.

### R325.5438. Class AA installations.

**Rule 438. (1)** In class AA installations the accelerator and objects exposed thereto shall be contained within a permanent enclosure.

(2) The enclosure shall be constructed such that the radiation exposure dose equivalent rate as measured in air at a distance of 5 centimeters from any accessible point on the external surface shall not exceed 2 millirems per hour under conditions of maximum radiation output permitted by the design or operating characteristics of the accelerator.

(3) Mechanical or electrical limiters shall limit movement or alignment of the accelerated beam within the enclosure if necessary to comply with subrule (2).

(4) A personnel barrier posted in accord with rules 224 to 231 restricting access to the roof of the enclosure shall meet the requirement of subrule (2).

(5) Reliable interlocks shall be provided which will prevent anyone from opening the enclosure while the accelerator is in operation or which will terminate machine operation should anyone open the enclosure. These interlocks

shall comply with rule 448.

(6) Enclosures of sufficient size to permit human occupancy shall be provided with visible or audible signals or both within the enclosure which are activated a minimum of 5 seconds before accelerator operation. Persons shall at all times be able to escape from within the enclosure.

(7) An individual shall not be permitted to remain within the enclosure while the accelerator is in operation except as a human patient undergoing radiation treatment.

(8) Protective enclosures and equipment shall be kept in good repair.

(9) Electron beam welders shall meet class AA requirements.

(10) Class AA approval permits unlimited use at maximum capacity.

#### **R325.5439. Class A installations.**

**Rule 439. (1)** Class A installations shall comply with all requirements of rule 438 except for a permissible exposure dose equivalent rate of 7 millirems per hour at any accessible external point.

(2) A personnel monitoring device, such as a film badge dosimeter or thermoluminescent dosimeter, shall be permanently assigned to each occupationally exposed individual. This monitoring shall be continuous during employment as a radiation worker.

(3) Personnel exposure records shall be kept on permanent available file at the facility where the exposure occurs.

(4) Class A approval permits unlimited use at maximum capacity.

#### **R325.5440. Class B installations.**

**Rule 440. (1)** Class B installations shall comply with all requirements of rule 439.

(2) Accelerator beam current and potential controls shall be mechanically or electrically limited so as not to exceed the normal operating conditions as specified by the applicant at the time of application for specific license or registration.

(3) Class B approval permits unlimited use under normal operating conditions as specified by subrule (2).

#### **R325.5441. Class C installations.**

**Rule 441. (1)** Class C installations shall comply with all requirements of rule 439 except for a permissible exposure

dose equivalent rate of 50 millirems per hour at any accessible external point.

(2) The maximum weekly accelerator beam on time shall be established by the department under the conditions specified by the registrant at the time of application for specific license or registration.

(3) Warning signs shall be posted in those areas outside the enclosure in which the radiation exposure dose equivalent rate in air at any accessible external point exceeds 2 millirems per hour under conditions of maximum radiation output permitted by the design or limited operating characteristics of the accelerator.

(4) A daily usage log shall be maintained to record machine operation. The record shall be available at the accelerator site for examination by the department.

#### **R325.5442. Class D operations.**

**Rule 442. (1)** Particle accelerator operations conducted under conditions not meeting the provisions and requirements of rules 438 to 441 shall be classified as class D operations and shall not be operated longer than 30 days unless written authorization is granted by the department.

(2) Written authorization in the form of a specific license or registration condition may be granted by the department for class D operations longer than 30 days but not longer than 6 months at any 1 location when an undue and unnecessary hardship may result from the 30 day limitation. Written request by the applicant for this authorization is required and shall describe the hardship involved as well as provide written assurance of compliance with the requirements of these rules for class D operation. This assurance shall be in the form of satisfactory written procedures which shall be approved by the department before the issuance of a specific license or certificate of registration.

### **SAFETY REQUIREMENTS FOR THE USE OF PARTICLE ACCELERATORS**

#### **R325.5445. General provisions.**

**Rule 445. (1)** Rules 445 to 455 establish radiation safety requirements for the use of particle accelerators. The provisions of such rules are in addition to, and not in substitution for, other applicable provisions of these rules.

(2) A licensee or registrant shall be responsible for assuring that all requirements of this part are met.

#### **R325.5446. Limitations.**

**Rule 446. (1)** A licensee or registrant shall not permit an individual to act as an accelerator operator until the individual:

- (a) Has been instructed in radiation safety and has demonstrated an understanding thereof.
- (b) Has received copies of and instruction in this part and the applicable requirements of part 5, pertinent license or registration conditions, and the licensee's or registrant's operating and emergency procedures, and has demonstrated understanding thereof.
- (c) Has demonstrated competence to use the particle accelerator, related equipment, and survey instruments which will be employed in his assignment.

(2) The radiation safety committee or the radiation protection supervisor shall have the authority to terminate the operations at an accelerator facility or of a class D operation if this action is deemed necessary to protect health and minimize danger to public health and safety or property.

#### **R325.5447. Shielding.**

**Rule 447. (1)** The design and shielding specifications for an accelerator shall be submitted and approved before issuance of a license by the department. After construction and installation the radiation safety of the installation shall be established by a protection survey conducted in accord with rule 221. A written report of the initial survey shall be submitted to the department and approved in writing before continued operation of the accelerator.

(2) Each accelerator installation shall be provided with such primary or secondary barriers as are necessary to assure compliance with rules 203, 205 and 211.

#### **R325.5448. Accelerator controls and interlock systems.**

**Rule 448. (1)** Instrumentation, readouts and controls on the accelerator control console shall be clearly identified and easily discernible.

(2) All entrances or openings into a target room or other high radiation area shall be provided with interlocks.

(3) When an interlock system has been tripped, it shall only be possible to resume operation of the accelerator by manually resetting controls at the position where the interlock has been tripped, and lastly at the main control console.

(4) A safety interlock shall be on a circuit which shall allow its operation independently of all other safety interlocks.

(5) A safety interlock shall be fail safe, i.e., designed so that any defect or component failure in the interlock system prevents operation of the accelerator.

(6) A scram button or other emergency power cutoff switch shall be located and easily identifiable in all high radiation areas. This cutoff switch shall include a manual reset so that the accelerator cannot be restarted from the accelerator control console without resetting the cutoff switch.

#### **R325.5449. Warning devices.**

**Rule 449. (1)** Locations designated as high radiation areas, and entrances to these locations shall be equipped with easily observable warning lights that operate when, and only when, radiation is being produced.

(2) Except in installations designed for human exposure, each high radiation area shall have an audible warning device which shall be activated for 15 seconds before the possible creation of a high radiation area. This warning device shall be clearly discernible in all high radiation areas and all radiation areas.

(3) Barriers, temporary or otherwise, and pathways leading to high radiation areas shall be identified in accordance with rules 224 to 233.

#### **R325.5450. Equipment control and operations.**

**Rule 450. (1)** A particle accelerator shall not be left unattended without locking the control panel in some manner which will prevent its use by unauthorized persons.

(2) A building housing a fixed particle accelerator shall not be left unattended without locking the building or portions thereof in some manner which will prevent unauthorized entry into the control room or target room, or any access to areas which may contain induced radioactivity resulting from accelerator operation.

(3) A mobile or portable particle accelerator shall not be left unattended without locking the room or building in which it is housed in some manner which will prevent its removal by unauthorized persons.

(4) Access to or possession of keys or combinations used to comply with the requirements of subrules (1) to (3) shall be limited to specific authorized persons approved by the radiation protection supervisor.

(5) Only a switch on the accelerator control console shall be routinely used to turn the accelerator beam on and off. The safety interlock system shall not be used to turn off the accelerator beam except in an emergency or during periodic testing of the interlock system.

(6) All safety and warning devices, including interlocks, shall be checked for proper operability at intervals not to exceed 3 months. Results of these tests shall be maintained for inspection by the department at the accelerator installation.

(7) Electrical circuit diagrams of the accelerator, and the associated interlock systems, shall be kept current and on file at each accelerator installation.

(8) If for any reason, it is necessary to intentionally bypass a safety interlock or interlocks, such action shall be:

- (a) Authorized by the radiation protection supervisor pursuant to rule 241.
- (b) Recorded in a permanent log and a notice posted at
- (c) Terminated as soon as possible.

(9) A copy of the operating and the emergency procedures shall be maintained at the accelerator control panel.

**R325.5452. Radiation surveys.**

**Rule 452. (1)** A licensee or registrant shall maintain at each accelerator installation or class D operation appropriate calibrated and operable portable radiation monitoring instruments to make physical radiation surveys as required by this part and part 5.

(2) These instruments shall be capable by design, calibration and operation of measuring the intensity of the various types and energies of radiation produced by the accelerator. These instruments shall be tested for proper operation at the beginning of each day they are to be used and calibrated at intervals not to exceed 3 months.

(3) During repair or calibration of a radiation monitoring instrument, a spare calibrated and operable instrument shall be provided or accelerator operations which require the instrument shall be terminated until required instrumentation is available.

(4) A radiation protection survey shall be performed and documented in accord with rule 221 when changes have been made in shielding, operation, equipment or occupancy of adjacent areas, and periodically to check for unknown changes and malfunctioning equipment.

(5) Radiation levels in all accessible high radiation areas shall be continuously monitored except in installations designed for human exposure. The monitoring devices shall be independent and capable of providing a remote and local readout with visual or audible alarms or both at the control panel and at the monitoring stations.

(6) All area monitors shall be calibrated at established periodic intervals approved by the department.

(7) Whenever applicable, periodic surveys shall be made to determine the amount of airborne radioactivity present in areas of airborne hazards.

(8) Whenever applicable, periodic smear surveys shall be made to determine the degree of contamination in target and other pertinent areas.

(9) All area surveys shall be made in accordance with the written procedures established by a health physics consultant or the radiation protection supervisor of the accelerator facility and approved by the department.

the accelerator control console.

(10) Records of all radiation protection surveys, calibration results, instrumentation tests and smear results shall be kept current and on file at each accelerator facility.

*[Note: The requirements of this rule that pertain to radiation machine registration, licensing, or compliance are under the purview of the Michigan Department of Consumer & Industry Services.]*

**R325.5455. Special precautions.**

**Rule 455.** A licensee or registrant shall not permit dismantling, repair or servicing of any portion of the accelerator or changing of target materials by any persons unless such persons have been approved for such activity by the radiation protection supervisor. The radiation protection supervisor shall determine that such persons are:

- (a) Qualified by training or experience to conduct such activities safely with respect to potential radiation hazards.
- (b) Knowledgeable regarding the potential hazards of induced radioactivity.
- (c) Provided with appropriate monitoring instruments and dosimeters.
- (d) Informed of any special procedures or precautions necessary to protect themselves and other from radiation exposure or spread of contamination.